



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

| APPLICATION NO.  | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|--|-------------|----------------------|---------------------|------------------|
| 10/773,197   | 02/09/2004  | Kia Silverbrook      | MTB29US             | 8277             |
| 24011  | 7590        | 03/17/2006           | EXAMINER            |                  |
| SILVERBROOK RESEARCH PTY LTD<br>393 DARLING STREET<br>BALMAIN, NSW 2041<br>AUSTRALIA |             |                      | CHOI, HAN S         |                  |
|  |             |                      | ART UNIT            | PAPER NUMBER     |
|  |             |                      | 2853                |                  |

DATE MAILED: 03/17/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

|                              |                               |                                  |  |
|------------------------------|-------------------------------|----------------------------------|--|
| <b>Office Action Summary</b> | Application No.<br>10/773,197 | Applicant(s)<br>SILVERBROOK, KIA |  |
|                              | Examiner<br>Han S. Choi       | Art Unit<br>2853                 |  |

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --**

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-54 is/are pending in the application.  
     4a) Of the above claim(s) \_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-54 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 09 February 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
     Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
     Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
     a) ☐ All    b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |   |   |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. ____. |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)  | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>12/16/04</u> . | 6) <input type="checkbox"/> Other: ____.  |

## **DETAILED ACTION**

### ***Specification***

1. Applicant is reminded of the proper language and format for an abstract of the disclosure.

The abstract should be in narrative form and generally limited to a single paragraph on a separate sheet within the range of 50 to 150 words. It is important that the abstract not exceed 150 words in length since the space provided for the abstract on the computer tape used by the printer is limited. The form and legal phraseology often used in patent claims, such as "means," "said," and "comprises" should be avoided. The abstract should describe the disclosure sufficiently to assist readers in deciding whether there is a need for consulting the full patent text for details.

The language should be clear and concise and should not repeat information given in the title. It should avoid using phrases which can be implied, such as, "The disclosure concerns," "The disclosure defined by this invention," "The disclosure describes," etc.

2. The abstract of the disclosure is objected to because the abstract contains the word "comprises" in Line 1. Correction is required. See MPEP § 608.01(b).

### ***Double Patenting***

3. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

Art Unit: 2853

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

4. Claims 1-54 are provisionally rejected on the ground of nonstatutory

obviousness-type double patenting as being unpatentable over claims 1-54 of

copending Application No. 10/779192 (Pub. No. US 2004/0160489) in view of

Silverbrook (US Pat. 5,905,517).

The claims of the copending application contain all the limitations of the pending application except for the nozzle aperture with a nozzle axis extending through the center of the nozzle aperture and normal to the nozzle aperture and the heater element having two planes of symmetry intersecting along the nozzle axis pertaining to claims 1, 19, and 38.

Silverbrook ('517) teaches the remaining limitations. Silverbrook teaches in [Col. 4, Lines 32-34] a nozzle hole along an axis which is generally normal to the plane of the heater and which is concentric with the heater outline. The concentricity of the nozzle and the heater defines the heater to have symmetry along any plane intersecting along the nozzle axis. Figs. 11b and 11c meet the stated limitation also taught in [Col. 41, Lines 21-25].

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the teachings of Silverbrook ('517) with the

compending application for the purpose of minimizing variations in heater width in [Col. 42, Lines 21-25].

This is a provisional obviousness-type double patenting rejection.

***Claim Rejections - 35 USC § 103***

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. Claims 1, 12, 19, and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,905,517) and Mitani et al. (US Pat. 5,831,648).

Ims teaches a plurality of nozzles in [Col. 8, Lines 44-45], a bubble forming chamber corresponding to each of the nozzles respectively in [Col. 8, Lines 6-9]. Ims teaches at least one heater element disposed in each of the bubble forming chambers respectively in [Col. 8, Lines 10-11]. Ims teaches a heater element configured for thermal contact with a bubble forming liquid to heat the heater element to a temperature above the boiling point of the bubble forming liquid to form a gas bubble that causes the ejection of a drop of an ejectable liquid through the nozzle corresponding that that heater element in [Col. 5, Lines 39-50]. Ims does not teach the nozzle aperture with a nozzle axis extending through the center of the nozzle aperture and normal to the nozzle aperture and the heater element having two planes of symmetry intersecting

along the nozzle axis. Ims does not teach the gas bubble collapsing to a collapse point spaced from the heater element.

Silverbrook teaches in [Col. 4, Lines 32-34] a nozzle hole along an axis which is generally normal to the plane of the heater and which is concentric with the heater outline. The concentricity of the nozzle and the heater defines the heater to have symmetry along any plane intersecting along the nozzle axis. Figs. 11b and 11c meet the stated limitation also taught in [Col. 41, Lines 21-25].

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the teachings of Silverbrook with the printhead of Ims for the purpose of minimizing variations in heater width in [Col. 42, Lines 21-25].

Mitani et al. teaches a bubble collapsing at a position which is distant from the point where the bubble nucleates in [Col. 16, Lines 61-67] shown in Fig. 17D.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the teaching of Mitani et al. with the modified printhead of Ims for the purpose of causing the ink to flow towards the orifice.

7. Claims 2, 3, 6, 20, 21, and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,905,517) and Mitani et al. (US Pat. 5,831,648) as applied to claims 1 and 19 above, and further in view of Pan (US Pat. 4,894,664).

Ims in view of Silverbrook and Mitani et al. disclose the basic elements of the claimed invention except the bubble forming chamber having a circular cross section and the heater element as a suspended beam extending diametrically across the bubble forming chamber and the heater element having an enclosed geometric shape formed between the ends of the suspended beam.

Pan teaches the heater element as a suspended beam [64] mounted at its respective ends to laterally opposing portions [66] of the bubble-forming chamber in [Cols. 4 and 5, Lines 35-38 and 43-46]. Pan teaches the bubble-forming chamber having a circular cross section [78] in [Col. 4, Lines 54-65] shown in Fig. 11 (the annular ring [78] define the upper ink reservoir where the heater heats the ink) and the portions of the chamber [66] that the heater element [60] mount to are diametrically opposed in [Col. 4, Lines 35-38]. Pan teaches the heater element [15] has an enclosed geometric shape formed between the ends of the suspended beam [23] shown in Fig. 10. Pan teaches the printhead configured as a page-width array in the abstract.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the teachings of Pan with the printhead of Ims in view of Silverbrook and Mitani et al. for the purpose of increasing the lifetime of the resistive heater element and defining the upper ink reservoir.

8. Claims 4 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,905,517) and Mitani et al. (US

Pat. 5,831,648) and further in view of Pan (US Pat. 4,894,664) as applied to claim 3 above, and further in view of Kubby (US Pat. 5,706,041).

Ims in view of Silverbrook and Mitani et al. and further in view of Pan disclose the basic elements of the claimed invention except the enclosed geometric shape having a higher resistance than the remainder of the element.

Kubby teaches that any number of regions [20 and 22] within the suspended portion [18] of the heater may be made to any particular resistivity in [Col. 3, Lines 53-67] shown in Figs. 1 and 2.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the teaching of Kubby to the heater element of Ims in view of Silverbrook and Mitani et al. and further in view of Pan for the purpose of making resistors with varying resistivities for different functions.

9. Claims 11, 18, 23, 30, and 37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,905,517) and Mitani et al. (US Pat. 5,831,648) as applied to claims 1 and 19 above, and further in view of Kubby (US Pat. 5,706,041).

Ims in view of Silverbrook and Mitani et al. disclose the basic elements of the claimed invention except the heater element having two opposite sides and configured such that a gas bubble formed by the heater element is formed at both of the sides of the heater element, supporting the bubble forming liquid in thermal contact with each heater element and ejectable liquid adjacent each nozzle, and the heater element



substantially covered by a conformal protective coating, all sides of the coating being seamless.

Kubby teaches the heater element [20a and 20b] causing a gas bubble to be formed on both sides of the heater element [20a or 20b] in [Col. 4, Lines 59-63]. Kubby teaches a configuration to support the bubble forming liquid in thermal contact with each said heater element, and to support the ejectable liquid adjacent each nozzle in [Col. 3, Lines 13-24] shown in Fig. 2. Kubby teaches a heater element [20a or 20b] that is substantially covered by a protective coating substantially to all sides, which are seamless in [Col. 4, Lines 32-50] shown in Fig. 4.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the elements taught by Kubby to the printhead of Ims in view of Silverbrook and Mitani et al. for the purpose of ejecting a sufficient amount of ink from the ejector, properly heating the ink, and protecting the heater.

10. Claims 5 and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,905,517) and Mitani et al. (US Pat. 5,831,648) as applied to claims 1 and 19 above, and further in view of Dunn (US Pat. 4,982,199).

Ims in view of Silverbrook and Mitani et al. disclose the basic elements of the claimed invention except for the bubble forming liquid and the ejectable liquid being a common body of liquid.

Dunn teaches the bubble forming liquid and the ejectable liquid common to each other in [Col. 2, Lines 31-38] (the bubble is created from the same ink as the ink that is ejected).

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the teachings of Dunn with the printhead of Ims in view of Silverbrook and Mitani et al. for the purpose of heating the same ink with a heater to create a bubble to cause the ejection of ink.

11. Claims 10 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,905,517) and Mitani et al. (US Pat. 5,831,648) as applied to claims 1 and 19 above, and further in view of Feinn et al. (US Pat. 6,543,879).

Ims in view of Silverbrook and Mitani et al. disclose the basic elements of the claimed invention except for a nozzle density greater than 10000 nozzles/cm<sup>2</sup>.

Feinn et al. teaches in [Col. 2, Lines 1-14] a nozzle packing density of at least 100 nozzles/mm<sup>2</sup>, which is equal to 10000 nozzles/cm<sup>2</sup> when converted to square centimeters.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the nozzle density of Feinn et al. to the printhead of Ims in view of Silverbrook and Mitani et al. for the purpose of accommodating higher printing resolutions and to improve the printhead drop generation rate in [Col. 1, Lines 57-61].

12. Claims 8, 13, 27, and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,905,517) and Mitani et al. (US Pat. 5,831,648) as applied to claims 1 and 19 above, and further in view of Silverbrook (US Pat. 5,841,452).

Ims in view of Silverbrook ('517) and Mitani et al. disclose the basic elements of the claimed invention except for the heater element configured such that an actuation energy of less than 500 nanojoules is required to heat the heater element sufficiently to form a bubble to cause the ejection of a drop and except for a structure incorporating nozzles formed by chemical vapor deposition (CVD).

Silverbrook ('452) teaches that typically 200 nanojoules is required to eject a drop by heating the heater element in [Col. 18, Lines 15-18]. Silverbrook ('452) teaches a thick chemical vapor deposition (CVD) glass over coat [142] which forms the nozzle region in [Col. 9, Lines 57-58] shown in Fig. 12.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the requirement of applying a typical heating energy of 200 nanojoules and a nozzle plate formed by chemical vapor deposition (CVD) to the heating element and printhead of Ims in view of Silverbrook ('517) and Mitani et al. for the purpose of maintaining print speed while reducing power dissipation and to provide mechanical strength to resist the shock of exploding or collapsing vapor bubbles and to provide protection against the external environment in [Col. 8, Lines 22-25].

13. Claims 14 and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,905,517) and Mitani et al. (US Pat. 5,831,648) as applied to claims 1 and 19 above, and further in view of Kashino et al. (US Pat. 5,534,898).

Ims in view of Silverbrook and Mitani et al. disclose the basic elements of the claimed invention except for a nozzle plate of the printhead having a thickness of less than 10 microns.

Kashino et al. teaches a thickness of an orifice plate in the order of several microns in [Col. 6, Lines 34-41].

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the thickness of the Kashino et al. nozzle plate to the Ims in view of Silverbrook and Mitani et al. printhead for the purpose of obtaining adequate values of the velocity of the discharged ink droplets, amount of ink droplet and refilling frequency, and in consideration of the distance between the thermal energy generating element and the discharge port.

14. Claims 15 and 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,905,517) and Mitani et al. (US Pat. 5,831,648) as applied to claims 1 and 19 above, and further in view of Komuro (US Pat. 4,965,594).

Ims in view of Silverbrook and Mitani et al. disclose the basic elements of the claimed invention except for a plurality of nozzle chambers each corresponding to a respective nozzle, and a plurality of said heater elements being disposed within each chamber, the heater elements within each chamber being formed on different respective layers to one another.

Komuro teaches heating resistors [11A, 21, and 31] of a first, second, and third layer formed on different respective layers and a plurality of nozzles [2] having chambers [4] with heaters [11A, 21, and 31] disposed within in [Cols. 3 and 4, Lines 25-68 and 1-34] shown in Figs. 1-4.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the stated structure of Komuro with the printhead of Ims in view of Silverbrook and Mitani et al. for the purpose of keeping discharge speed and frequency characteristics in a stable manner.

15. Claims 7, 16, 26, and 35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,905,517) and Mitani et al. (US Pat. 5,831,648) as applied to claims 1 and 19 above, and further in view of Chan (US Pat. 5,710,070).

Ims in view of Silverbrook and Mitani et al. disclose the basic elements of the claimed invention except for a heater element formed of solid material of which more than 90% of which, by atomic proportion, is constituted by at least one periodic element

having an atomic number below 50 and the heater element predominantly formed by titanium nitride.

Chan teaches a thermal inkjet printhead comprising a resistive layer composed of titanium nitride, which forms a resistor and a contact metal barrier layer in [Col. 2, Lines 10-14]. Titanium has an atomic number less than 50 on the periodic table.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the titanium nitride resistor to the printhead of Ims in view of Silverbrook and Mitani et al. for the purpose of having resistors that are more reliable, especially at higher temperatures and less complicated to manufacture.

16. Claims 17 and 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,905,517) and Mitani et al. (US Pat. 5,831,648) as applied to claims 1 and 19 above, and further in view of Pan et al. (US Pat. 4,931,813).

Ims in view of Silverbrook and Mitani et al. disclose the basic elements of the claimed invention except for the heater element configured to a mass of less than 10 nanograms.

Pan et al. discloses the heater element including a solid that is heated to form a bubble vapor to cause ejection of an ink drop, but does not explicitly teach the solid having a mass less than 10 nanograms. It would have been obvious at the time the invention was made to a person having ordinary skill in the art at the time the invention was made to apply at least 10 nanograms of the solid material to the heating element of

Ims in view of Silverbrook and Mitani et al. printhead to cause an ejection of an ink drop since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F.2d 272, 205 USPQ (CCPA 1980.)

17. Claims 9 and 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,905,517) and Mitani et al. (US Pat. 5,831,648) as applied to claims 1 and 19 above, and further in view of Silverbrook (US Pat. 5,856,836).

Ims in view of Silverbrook ('517) and Mitani et al. disclose the basic elements of the claimed invention except for the printhead configured to receive a supply of the ejectable liquid at an ambient temperature, wherein each heater element is configured such that the energy required to be applied to heat the heater element to cause ejection of an ink drop is less than the energy required to heat a volume of an ejectable liquid equal to the volume of the ink drop, from an ambient temperature to the boiling point.

Silverbrook ('836) teaches in [Col. 4, Lines 59-65] comprising a thermally activated liquid ink printing head being characterized by the energy required to eject a drop of ink being less than the energy required to raise the temperature of the received supply of ink of a volume equal to the volume of said ink drop above the ambient ink temperature to below ejection temperature. Ejection temperature is referred to in Claims 1 and 19 as the temperature above boiling point. Therefore, "below ejection temperature" would include the boiling point.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the teaching of Silverbrook ('836) with the printhead of Ims in view of Silverbrook ('517) and Mitani et al. for the purpose of providing a higher nozzle density per row, a manufacturing process for the printhead with low production costs, and to dissipate the full amount of the active power in the printed ink itself.

18. Claims 38 and 48 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,905,517) and Mitani et al. (US Pat. 5,831,648) and Fukuchi et al. (US Pat. 4,549,191).

Ims teaches a plurality of nozzles in [Col. 8, Lines 44-45], a bubble forming chamber corresponding to each of the nozzles respectively in [Col. 8, Lines 6-9]. Ims teaches at least one heater element disposed in each of the bubble forming chambers respectively in [Col. 8, Lines 10-11]. Ims teaches a heater element configured for thermal contact with a bubble forming liquid to heat the heater element to a temperature above the boiling point of the bubble forming liquid to form a gas bubble that causes the ejection of a drop of an ejectable liquid through the nozzle corresponding that that heater element in [Col. 5, Lines 39-50]. Ims does not teach the nozzle aperture with a nozzle axis extending through the center of the nozzle aperture and normal to the nozzle aperture and the heater element having two planes of symmetry intersecting along the nozzle axis. Ims does not teach the gas bubble collapsing to a collapse point



spaced from the heater element. Ims does not teach supplying the nozzle with a replacement volume of the ejectable liquid equivalent to the ejected drop.

Silverbrook teaches in [Col. 4, Lines 32-34] a nozzle hole along an axis which is generally normal to the plane of the heater and which is concentric with the heater outline. The concentricity of the nozzle and the heater defines the heater to have symmetry along any plane intersecting along the nozzle axis. Figs. 11b and 11c meet the stated limitation also taught in [Col. 41, Lines 21-25].

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the teachings of Silverbrook with the printhead of Ims for the purpose of minimizing variations in heater width in [Col. 42, Lines 21-25].

Mitani et al. teaches a bubble collapsing at a position which is distant from the point where the bubble nucleates in [Col. 16, Lines 61-67] shown in Fig. 17D.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the teaching of Mitani et al. with the modified printhead of Ims for the purpose of causing the ink to flow towards the surface.

Fukuchi et al. teaches replacing an amount equal in volume to the ink that was ejected from the nozzles in [Col. 1, Lines 35-38].

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the teaching of Fukuchi et al. with the modified printhead of Ims for the purpose of preventing ink degeneration in the pressure chamber in [Col. 3, Lines 51-58].

19. Claims 39, 40, and 43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,905,517) and Mitani et al. (US Pat. 5,831,648) and Fukuchi et al. (US Pat. 4,549,191) as applied to claim 38 above, and further in view of Pan (US Pat. 4,894,664).

Ims in view of Silverbrook and Mitani et al. and Fukuchi et al. disclose the basic elements of the claimed invention except the bubble forming chamber having a circular cross section and the heater element as a suspended beam extending diametrically across the bubble forming chamber and the heater element having an enclosed geometric shape formed between the ends of the suspended beam.

Pan teaches the heater element as a suspended beam [64] mounted at its respective ends to laterally opposing portions [66] of the bubble-forming chamber in [Cols. 4 and 5, Lines 35-38 and 43-46]. Pan teaches the bubble-forming chamber having a circular cross section [78] in [Col. 4, Lines 54-65] shown in Fig. 11 (the annular ring [78] define the upper ink reservoir where the heater heats the ink) and the portions of the chamber [66] that the heater element [60] mount to are diametrically opposed in [Col. 4, Lines 35-38]. Pan teaches the heater element [15] has an enclosed geometric shape formed between the ends of the suspended beam [23] shown in Fig. 10. Pan teaches the printhead configured as a page-width array in the abstract.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the teachings of Pan with the printhead of Ims in view of Silverbrook and Mitani et al. and Fukuchi et al. for the purpose of

Art Unit: 2853

increasing the lifetime of the resistive heater element and defining the upper ink reservoir.

20. Claim 41 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,905,517) and Mitani et al. (US Pat. 5,831,648) and Fukuchi et al. (US Pat. 4,549,191) and further in view of Pan (US Pat. 4,894,664) as applied to claim 40 above, and further in view of Kubby (US Pat. 5,706,041).

Ims in view of Silverbrook and Mitani et al. and Fukuchi et al. and further in view of Pan disclose the basic elements of the claimed invention except the enclosed geometric shape having a higher resistance than the remainder of the element.

Kubby teaches that any number of regions [20 and 22] within the suspended portion [18] of the heater may be made to any particular resistivity in [Col. 3, Lines 53-67] shown in Figs. 1 and 2.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the teaching of Kubby to the heater element of Ims in view of Silverbrook and Mitani et al. and Fukuchi et al. and further in view of Pan for the purpose of making resistors with varying resistivities for different functions.

21. Claims 47 and 54 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,905,517) and Mitani et

al. (US Pat. 5,831,648) and Fukuchi et al. (US Pat. 4,549,191) as applied to claim 38 above, and further in view of Kubby (US Pat. 5,706,041).

Ims in view of Silverbrook and Mitani et al. and Fukuchi et al. disclose the basic elements of the claimed invention except the heater element having two opposite sides and configured such that a gas bubble formed by the heater element is formed at both of the sides of the heater element and the heater element substantially covered by a conformal protective coating, all sides of the coating being seamless.

Kubby teaches the heater element [20a and 20b] causing a gas bubble to be formed on both sides of the heater element [20a or 20b] in [Col. 4, Lines 59-63]. Kubby teaches a heater element [20a or 20b] that is substantially covered by a protective coating substantially to all sides, which are seamless in [Col. 4, Lines 32-50] shown in Fig. 4.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the elements taught by Kubby to the printhead of Ims in view of Silverbrook and Mitani et al. and Fukuchi et al. for the purpose of ejecting a sufficient amount of ink from the ejector and protecting the heater.

22. Claim 42 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,905,517) and Mitani et al. (US Pat. 5,831,648) and Fukuchi et al. (US Pat. 4,549,191) as applied to claim 38 above, and further in view of Dunn (US Pat. 4,982,199).

Ims in view of Silverbrook and Mitani et al. and Fukuchi et al. disclose the basic elements of the claimed invention except for the bubble forming liquid and the ejectable liquid being a common body of liquid.

Dunn teaches the bubble forming liquid and the ejectable liquid common to each other in [Col. 2, Lines 31-38] (the bubble is created from the same ink as the ink that is ejected).

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the teachings of Dunn with the printhead of Ims in view of Silverbrook and Mitani et al. and Fukuchi et al. for the purpose of heating the same ink with a heater to create a bubble to cause the ejection of ink.

23. Claim 46 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,905,517) and Mitani et al. (US Pat. 5,831,648) and Fukuchi et al. (US Pat. 4,549,191) as applied to claim 38 above, and further in view of Feinn et al. (US Pat. 6,543,879).

Ims in view of Silverbrook and Mitani et al. and Fukuchi et al. disclose the basic elements of the claimed invention except for a nozzle density greater than 10000 nozzles/cm<sup>2</sup>.

Feinn et al. teaches in [Col. 2, Lines 1-14] a nozzle packing density of at least 100 nozzles/mm<sup>2</sup>, which is equal to 10000 nozzles/cm<sup>2</sup> when converted to square centimeters.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the nozzle density of Feinn et al. to the printhead of Ims in view of Silverbrook and Mitani et al. and Fukuchi et al. for the purpose of accommodating higher printing resolutions and to improve the printhead drop generation rate in [Col. 1, Lines 57-61].

24. Claims 44 and 50 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,905,517) and Mitani et al. (US Pat. 5,831,648) and Fukuchi et al. (US Pat. 4,549,191) as applied to claim 38 above, and further in view of Silverbrook (US Pat. 5,841,452).

Ims in view of Silverbrook ('517) and Mitani et al. and Fukuchi et al. disclose the basic elements of the claimed invention except for the heater element configured such that an actuation energy of less than 500 nanojoules is required to heat the heater element sufficiently to form a bubble to cause the ejection of a drop and except for a structure incorporating nozzles formed by chemical vapor deposition (CVD).

Silverbrook ('452) teaches that typically 200 nanojoules is required to eject a drop by heating the heater element in [Col. 18, Lines 15-18]. Silverbrook ('452) teaches a thick chemical vapor deposition (CVD) glass over coat [142] which forms the nozzle region in [Col. 9, Lines 57-58] shown in Fig. 12.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the requirement of applying a typical heating energy of 200 nanojoules and a nozzle plate formed by chemical vapor

deposition (CVD) to the heating element and printhead of Ims in view of Silverbrook ('517) and Mitani et al. and Fukuchi et al. for the purpose of maintaining print speed while reducing power dissipation and to provide mechanical strength to resist the shock of exploding or collapsing vapor bubbles and to provide protection against the external environment in [Col. 8, Lines 22-25].

25. Claim 49 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,905,517) and Mitani et al. (US Pat. 5,831,648) and Fukuchi et al. (US Pat. 4,549,191) as applied to claim 38 above, and further in view of Kashino et al. (US Pat. 5,534,898).

Ims in view of Silverbrook and Mitani et al. and Fukuchi et al. disclose the basic elements of the claimed invention except for a nozzle plate of the printhead having a thickness of less than 10 microns.

Kashino et al. teaches a thickness of an orifice plate in the order of several microns in [Col. 6, Lines 34-41].

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the thickness of the Kashino et al. nozzle plate to the Ims in view of Silverbrook and Mitani et al. and Fukuchi et al. printhead for the purpose of obtaining adequate values of the velocity of the discharged ink droplets, amount of ink droplet and refilling frequency, and in consideration of the distance between the thermal energy generating element and the discharge port.

26. Claim 51 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,905,517) and Mitani et al. (US Pat. 5,831,648) and Fukuchi et al. (US Pat. 4,549,191) as applied to claim 38 above, and further in view of Komuro (US Pat. 4,965,594).

Ims in view of Silverbrook and Mitani et al. and Fukuchi et al. disclose the basic elements of the claimed invention except for a plurality of nozzle chambers each corresponding to a respective nozzle, and a plurality of said heater elements being disposed within each chamber, the heater elements within each chamber being formed on different respective layers to one another.

Komuro teaches heating resistors [11A, 21, and 31] of a first, second, and third layer formed on different respective layers and a plurality of nozzles [2] having chambers [4] with heaters [11A, 21, and 31] disposed within in [Cols. 3 and 4, Lines 25-68 and 1-34] shown in Figs. 1-4.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the stated structure of Komuro with the printhead of Ims in view of Silverbrook and Mitani et al. and Fukuchi et al. for the purpose of keeping discharge speed and frequency characteristics in a stable manner.

27. Claim 52 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,905,517) and Mitani et al. (US Pat. 5,831,648) and Fukuchi et al. (US Pat. 4,549,191) as applied to claim 38 above, and further in view of Chan (US Pat. 5,710,070).



Imms in view of Silverbrook and Mitani et al. and Fukuchi et al. disclose the basic elements of the claimed invention except for a heater element formed of solid material of which more than 90% of which, by atomic proportion, is constituted by at least one periodic element having an atomic number below 50.

Chan teaches a thermal inkjet printhead comprising a resistive layer composed of titanium nitride, which forms a resistor and a contact metal barrier layer in [Col. 2, Lines 10-14]. Titanium has an atomic number less than 50 on the periodic table.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the titanium nitride resistor to the printhead of Imms in view of Silverbrook and Mitani et al. and Fukuchi et al. for the purpose of having resistors that are more reliable, especially at higher temperatures and less complicated to manufacture.

28. Claim 53 is rejected under 35 U.S.C. 103(a) as being unpatentable over Imms (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,905,517) and Mitani et al. (US Pat. 5,831,648) and Fukuchi et al. (US Pat. 4,549,191) as applied to claim 38 above, and further in view of Pan et al. (US Pat. 4,931,813).

Imms in view of Silverbrook and Mitani et al. and Fukuchi et al. disclose the basic elements of the claimed invention except for the heater element configured to a mass of less than 10 nanograms.

Pan et al. discloses the heater element including a solid that is heated to form a bubble vapor to cause ejection of an ink drop, but does not explicitly teach the solid

having a mass less than 10 nanograms. It would have been obvious at the time the invention was made to a person having ordinary skill in the art at the time the invention was made to apply at least 10 nanograms of the solid material to the heating element of Ims in view of Silverbrook and Mitani et al. and Fukuchi et al. printhead to cause an ejection of an ink drop since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F.2d 272, 205 USPQ (CCPA 1980.)

29. Claim 45 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Silverbrook (US Pat. 5,905,517) and Mitani et al. (US Pat. 5,831,648) and Fukuchi et al. (US Pat. 4,549,191) as applied to claim 38 above, and further in view of Silverbrook (US Pat. 5,856,836).

Ims in view of Silverbrook ('517) and Mitani et al. and Fukuchi et al. disclose the basic elements of the claimed invention except for the printhead configured to receive a supply of the ejectable liquid at an ambient temperature, wherein each heater element is configured such that the energy required to be applied to heat the heater element to cause ejection of an ink drop is less than the energy required to heat a volume of an ejectable liquid equal to the volume of the ink drop, from an ambient temperature to the boiling point.

Silverbrook ('836) teaches in [Col. 4, Lines 59-65] comprising a thermally activated liquid ink printing head being characterized by the energy required to eject a drop of ink being less than the energy required to raise the temperature of the received

supply of ink of a volume equal to the volume of said ink drop above the ambient ink temperature to below ejection temperature. Ejection temperature is referred to in Claims 1 and 19 as the temperature above boiling point. Therefore, "below ejection temperature" would include the boiling point.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the teaching of Silverbrook ('836) with the printhead of Ims in view of Silverbrook ('517) and Mitani et al. and Fukuchi et al. for the purpose of providing a higher nozzle density per row, a manufacturing process for the printhead with low production costs, and to dissipate the full amount of the active power in the printed ink itself.

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Han S. Choi whose telephone number is (571) 272-8350. The examiner can normally be reached on Monday - Friday, 8:30am to 5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stephen Meier can be reached on (571) 272-2149. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Art Unit: 2853

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

HSC  
3/14/06



HAI PHAM  
PRIMARY EXAMINER